WHY ARE THERE SO MANY ORGANIZATIONS: CLUSTER INNOVATION MECHANISM AND ITS EXTERNAL EFFECT ON THE CHINESE SMES

Liqin Ren
Lecturer
University of Twente
l.ren@utwente.nl

Guangya Xie
Beijing University of Technology

Koos Krabbendam
Professor of Operations Management
University of Twente
j.j.krabbendam@utwente.nl

Abstract
Purpose – The once SOE-dominated China has witnessed numerous SMEs in the past two decades. This paper aims to provide the Chinese SMEs with a cluster-like development option so that the SMEs can better compete in the domestic and world market.
Approach – The competitive advantages of cluster firms consist of cost advantage and technological innovation advantage. Cost advantage is the basic competitive advantage of cluster firms, and innovation advantage is the long-term competitive advantage of cluster firms. This paper links these two advantages in a framework and further studies the horizontal and the vertical level of cooperation and competition behavior among the cluster firms. It explores the cluster innovation mechanism for and its potential external economic and non-economic effects on the Chinese SMEs. This paper distinguishes clearly the contents of cluster innovation.
Findings – Cluster firms could effectively combine SMEs' innovation vitality with innovation scale economy, and cultivating SMEs' distinguished innovation capabilities. In this paper, we analyzed the cluster innovation mechanism for the Chinese SMEs by using the firm behavior of horizontal and vertical cooperation and competition. Taking this as the basis, we explored the possible external effects of cluster innovation. On the one hand, cluster innovation can lower innovation cost and risk by promoting information spread, synergic competitive cooperation, sharing resources and facilities, congregate the talents and constructing cluster culture. On the other hand, cluster innovation may bring about external non-economical effects, like innovation laziness, "lemon market" and technology lockage, etc..
Research limitations/implication – This research uses many a theoretical work of Western scholars, and lacks empirical activities in China. In the future a few case studies or a structured questionnaire to the Chinese SMEs are desired.
Originality/value – Cluster innovation is recommended to be a feasible option for the Chinese SMEs in gaining innovation advantages in the long run.
Keywords cluster firms, technological innovation, small and medium-sized enterprises (SMEs)

Introduction

Cluster has been an old economic phenomenon. However, the renaissance of cluster theory re-started after almost a century's silence of the earliest study by Marshall in 1890 (Schmitz,

1995). In the mid-1980s, cluster firms, the small and medium-sized enterprises (SMEs) clusters in particular, showed great vitality as a new virtual organizational structure of firms in the economic system of developed countries. Since then the cluster study attracted again the academia's attention. In the meantime, research on innovation system has already experienced three main stages: entrepreneurial innovation capabilities, enterprise innovation system and national innovation system, and is now entering the new research field of regional innovation system.

The economic activity of a firm is generally considered as a process of allocating resources rationally, within the scope of time and space, for the maximized profit. Cluster firms are characterized as the virtually inter-related firms in a specific region. In the structure of clusters, there are flows of material, information, capital and labor among the firms, confluent into a multi-layered network. Cluster is a virtual organizational form between the market and the enterprises. It integrates various factors in a cooperative way for the maximum performance of the region as a whole.

The cost advantage is most essential for the clusters. The cooperative activities within the clusters can largely reduce the transaction costs, so that the external scale economy of cluster firms can be realized. However, if the cluster has only cost advantage, it may stop developing consequentially, and may even disappear because of the inconsistency of technology. Therefore, the sustainable development of cluster firms needs the upgrade of technological innovation capabilities, which basically depends on the construction and perfection of cluster innovation mechanisms.

In a word, the competitive advantage of clusters consists of cost advantage and innovation advantage. The cost advantage is the basic competitive advantage of clusters, and the innovation advantage is the long-term competitive advantage of clusters. The former comes into being with the emergence of the cluster, and the latter appears along with the non-transactional cooperation among the firms. This is illustrated in detail in Figure 1.

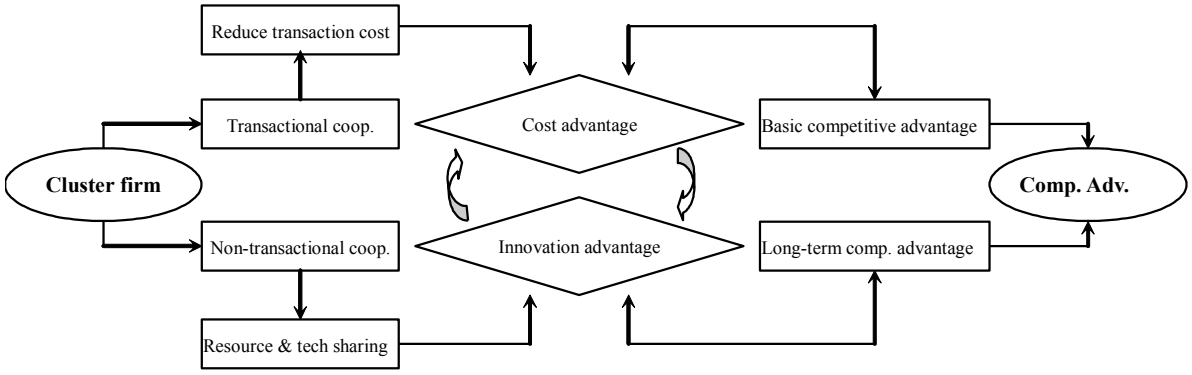

Figure 1:
Cost advantage and innovation advantage of cluster firms

This paper firstly reviews briefly the status quo of cluster innovation both in the West and in China, and then states the horizontal and vertical level of cooperation and competitive behavior among the cluster firms. Based on that, it explores the cluster innovation

mechanism and its potential external economic and non-economic effects on the Chinese SMEs. It is concluded that cluster innovation is a feasible option for the Chinese SMEs in gaining innovation advantage in the long run.

Current status of cluster innovation

Porter (1998) defines that clusters are the geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. In the industrial cluster, the relevant firms, the knowledge organizations, the traders on the production chain and the customers are interconnected to form an innovation network, or a cluster innovation system. Cluster innovation is an innovation process based on the technology development and application in a specific space, aiming to form cluster advantage. Cluster firms thus benefit from their access to the high levels of productivity and responsiveness of other specialized firms, and also from reduced inventory levels, and transportation costs (Khan and Ghani, 2004). Unlike the traditional technological innovation system, cluster innovation is not a linear process, but a highly interdependent system constructed by different organizations and departments in a specific region.

The successful emergence of innovative clusters, such as the Silicon Valley in the United States, Tsukuba in Japan, M_4 Corridor in the United Kingdom, Sophia-Antipotis in France, Taedok in South Korea, and Tsin-chu in Taiwan, have drawn wide attention of the academia and the practitioners. The European innovation environment school representatives, such as Gersbach, Schmutzler and Peter Swann, regard a mature cluster as an integrated whole. The Western researchers point out that the trigger for the firms to form clusters is technological innovation, and put forward a new theory: innovation milieu (Aydalot, 1986). DeBresson (1999) puts forward the hypothesis of innovation inter-dependence, arguing that networking/inter-firm networking has been a requirement for innovation. Feser and Bergman (2000) sumarize that the innovation advantages of clusters come from the external economy, the innovation milieu, the path dependence and the competitive cooperation.

The relevant research in China started a few years ago. Following Shang and Zhu (1999) that innovation drives clusters, and innovation network is the effective means for clusters. Qiu (1999) discusses how technological innovation diffuses among SME clusters as well as the “cluster effect” of technological innovation, and analyzes the relationship between SMEs and technological innovation. In his book *Innovation space: Clusters and regional development*, Wang (2001) gives a historical review of industrial cluster theory, puts forward some policy suggestions for the development of China’s clusters and construction of regional innovation environment. However, studies on the cluster innovation in China are still in the beginning stage, which still needs more efforts theoretically and in practice.

Small and medium-sized enterprises have come into shape in China, with most of them distributing in Zhejiang Province and Guangdong Province, east and south China. The SME industry in China is generally characterized as a cluster of loose contact with each other, low technology products and weak sense of cooperation. In fact, the flexible structure and the competition pressure make SMEs have more sense for innovation. SMEs react faster and are more sensitive for new technologies. However, the technological innovation process

requirements make it difficult for a single SME to accomplish the stages of innovation, such as the application, production, and commercialization of a new technology. Besides, the uncertainty of technological innovation itself may threaten the existence of an SME, thus small and medium-sized firms with limited capabilities see the need to share the risks with other SMEs through cooperation.

The cluster innovation mechanism

The modern innovation theory believes that both large firms and small firms have advantages and disadvantages in conducting technological innovation. It all depends on how firms react innovatively towards different market environment, and how firms adopt effective innovation mechanisms for effective innovation. In addition to enhancing productivity, clusters play a vital role in a company's ongoing ability to innovate. Some of the same characteristics that enhance current productivity have an even more dramatic effect on innovation and productivity growth (Porter, 1998).

A complete cluster is composed of a number of firms (and organizations) having different functions and positions. Suppliers, producers, consumers and traders are the main bodies in the cluster. SME cluster usually consists of many firms with relatively the same size. There are vertical relationships as well as horizontal relationships among those firms, and horizontal relationships are more obvious. Traditional empirical cluster research has only studied the vertical relationships. In fact, horizontal relationships have also been very important to SME cluster innovation. Essentially, the technological innovation in the SME cluster comes more from the horizontal competition and cooperation, while the vertical competition and cooperation among the firms lead to the occurrence of institutional innovation. Besides, in the strategic choice of competition or cooperation, SME cluster emphasizes the importance of cooperation behavior. However, cooperation does not necessarily lead to cluster, which should be fostered by the participants of the cluster themselves. Therefore, the behavior choice is significant to the innovation advantage of cluster firms.

Horizontal relationship in the cluster innovation mechanism

In the cluster innovation mechanism, the horizontal relationship of firms is embodied as the interaction of the similar firms. Such a relationship can be further divided into horizontal cooperative relationship and horizontal competitive relationship, as Porter (1998) says that clusters promote both competition and cooperation. Without vigorous competition, a cluster will fail. Yet there is also cooperation, much of it vertical, involving companies in related industries and local institutions. Competition can coexist with cooperation because they occur on different dimensions and among different players.

Horizontal cooperative relationship

Horizontal cooperative relationship has two layers: preliminary horizontal cooperative relationship and advanced horizontal cooperative relationship. They share some characteristics and exist in parallel in cluster innovation mechanism, showing the relationship of time evolvement.

The preliminary horizontal cooperation happens among a few firms, characterized by the borrowing of tools, or discussion of techniques between the owners or among the labors. This is usually an unconscious, low level cooperation. The advanced horizontal cooperative relationship is a conscious collective activity toward a mutual goal. A united organization is constructed to realize such a collective goal. In the preliminary stage, firms acquire innovation ideas from the other firms through observation and imitation; while this behavior evolves into an active united mutual beneficial behavior when firms are in the advanced cooperative stage. In a perfect innovation cluster, there are preliminary as well as advanced horizontal cooperation among the firms.

When the competitiveness of the cluster becomes strengthened, the strategic goal of the cluster may change and the competition may expand from within the cluster to a broader market outside the cluster. The key point at this time confronting many SMEs is how to overcome the restraints of scale and capacity so as to realize the breakthrough for development. For the cluster firms, on the one hand they seek for the enhancement of their own competitiveness, on the other hand, they may expect that the cluster owns stronger global competitiveness so that the cluster firms can increase the international reputation of their own. In this way, a broader and more solid basis is provided for the horizontal relationship among firms, and this horizontal relationship gradually evolves from the preliminary stage to the advanced stage, leading to a complete cluster innovation mechanism.

Horizontal competitive relationship

An obvious feature of SME cluster is that the firms are relatively small and are on the same level. Also there is low or no differentiation of their products. For such firms, competition is the purpose of cooperation, and cooperation is the means of competition. The fierce competition is the most important trigger for innovation (Porter, 1976). Competition keeps the richness of the cluster and the adaptation of the production activities in the cluster.

In view of the development stages of cluster innovation, horizontal competitive relationship is of significance in the beginning phase of a cluster formation. At the time, the cluster firms have loose relationship and limited scale, and similar production conditions. There are certain extent overlaps on the production activities among the firms (Malmberg and Maskell, 1997). The horizontal competition among the newly built cluster firms forces them to carry out product differentiation, take the initiative for research and development (R&D) and attempt new operation strategies. Cluster firms compare with each other and learn from the rival's advanced technology and processes, making technological innovation diffuse quickly among the cluster firms with the optimal economic effect. Such a horizontal competition creates in the cluster firms the full-bodied industrial atmosphere (Alfred, 1920) as well as a good innovation milieu (Aydalot, 1986). It is obvious that the horizontal competition in the cluster firm largely compensate the disadvantage of SMEs being isolated and setting up a separatist regime of their own. Although lacking of connections, firms may know their competitors through competition, for they operation under the same regulations and in the same environment (Bathelt, 2002; Gertler, 1993).

Vertical relationship in the cluster innovation mechanism

Compared to horizontal relationship, the vertical relationship in the cluster is more important to the sustainable, recurrent development of the cluster. Vertical relationship comes from firms which mutually supplement each other and are of different functions, consisting of usually three main bodies of producer, supplier and consumer.
In China, the SME cluster usually has an extraversion tendency. Therefore, the fourth main entity , i.e. trader has been added into our paper for discussion. Similar to the horizontal relationship, vertical relationship of clusters has also two types of behavior choice: cooperation and competition.

Vertical cooperative relationship
The vertical cooperative relationship in the cluster firm derives from the horizontal relationship of cluster. Following Krugman (2000) the formation process of vertical relationship in the cluster in this way: Once the clusters are certain about their production field, the firms in the cluster will demand specialized service and inputs (e.g. resources and equipment). The cluster of producers will automatically attract the join-in of specialized suppliers, which may greatly lower the sales costs of products and enlarge the need of specialized labor force. Consequentially, the enlarged labor force will attract more and new firms to join the cluster, thus realizing the automatic self recurrence of the cluster scale. Furthermore, the open up of foreign market makes it possible that traders also join the cluster, providing material and capital for the commercialization of products and realizing the materialization process of innovation (Alfred, 1920). In the end, the competitiveness of cluster will attract the consumers to purchase products from the cluster firms. Until now the vertical relationship of the cluster, based on the making of products and composed of producers, suppliers, consumers and traders, finally comes into being.

A better vertical cooperative relationship can further specify the division of labor of the main bodies in the cluster. This may supplement each other's function and reduce largely the institutional friction. This may also unite the advantages of the main bodies for joint innovation, assure the successiveness and effectiveness of the application process of new technologies, and shorten the innovation cycle.

Vertical competitive relationship
The vertical competitive relationship is embodied by the squeeze effect between the main bodies. According to Wei and Ye (2002), the squeeze effect means the competitive pressure that some cluster firms bring to other vertical firms. Because of the innovation activities and outcomes of some cluster firms, other related cluster firms are under the pressure to implement technological innovation so as to face the competition. In the production chain of the cluster, a technological innovation by any behavior entity may cause incremental or fundamental change of input and output; consequently it demands other behavior bodies to have adaptation, thus forming squeeze effect. The squeezed degree depends on the bargaining ability of the behavior entity itself. The lower the bargaining ability it has, the bigger squeezed degree it gets. This squeeze effect makes the vertical cluster innovation possible.

Besides the squeeze effect, the benign vertical competitive relationship can strengthen the localized capabilities (Gordon and McCann, 2000) of the cluster. The localized capabilities

include the specialized resource and technology, the regulated business rules and other local institutional structure. Producers, suppliers, consumers and traders continuously adjust their relationships in their instructional environment. In the vertical competitive cluster, the behavior choice of any behavior entity may influence the current demand and supply relationship, re-deploy the resource and infrastructure within the cluster. Such influence may normalize the existing organizational procedure and conventions, stimulate the further development of localized capabilities and deepen the competitive advantage of the cluster.
The horizontal relationship and the vertical relationship of SME cluster innovation is illustrated in Figure 2.

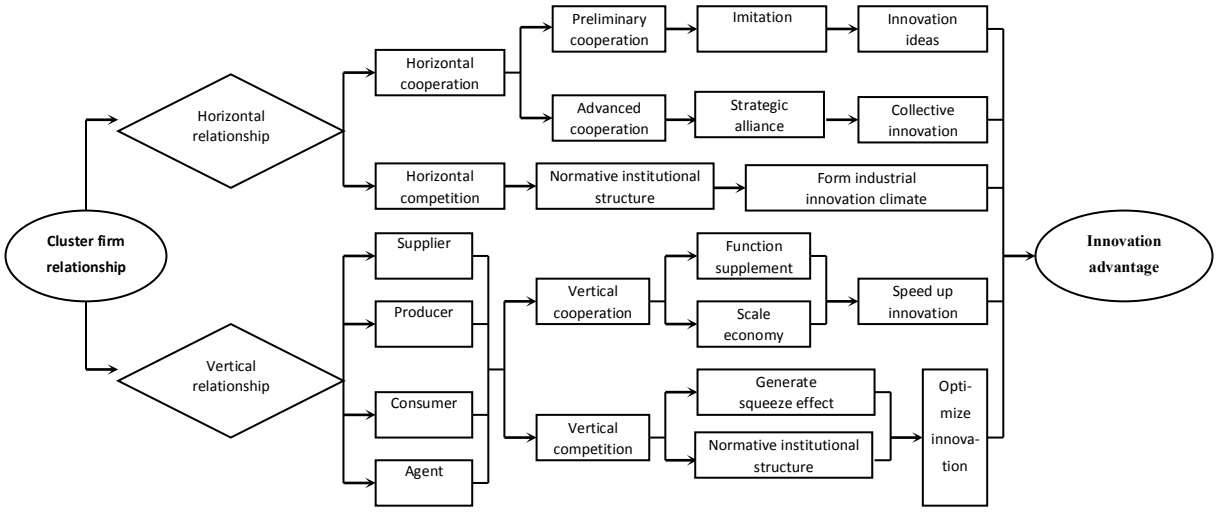

Figure 2:
Horizontal relationship and vertical relationship in SME cluster innovation mechanism

Discussion

As has been discussed above, cluster can effectively stimulate SMEs to generate innovation new ideas and provide them with innovation bodies. However, cluster has external economic effect as well as external non-economic effect. The external economic effect of cluster is mainly shown in the following five aspects.

(1) Promote the spread of information. Through the horizontal mechanism and the vertical mechanism, cluster realizes the spread of information in an efficient, high speed among the cluster firms. This fast diffusion of information ensures the behavior bodies to learn the latest knowledge, and effectively avoid the overlap of innovation activities within the cluster;

(2) Synergetic competitive cooperation. Based on specialized division of labor and coordination, the cluster firms, allocated along the product chain, are with great similarity and mutual supplement. Firms are close and are easy to communicate with each other. The competition within the cluster helps the specialized investment on the advanced production factors, such as infrastructure, science and technology, information, human resource, etc.. The cluster effect is increased, and the cluster realizes the benign recurrence of itself, and consequently strengthen the innovation advantage of the cluster;

(3) Share resources and facilities. The lack of innovation resources is a key factor that constrains the technological innovation of SMEs. The cluster can effectively let SMEs share some resources, including basic infrastructure, scientific research institutions, and so on. The share of resources provides excellent external conditions for cluster firm innovation, and increases the usage of basic infrastructure and other facilities, and lowers the fixed costs of firms. The ongoing relationships with other entities within the cluster also help companies to learn early about evolving technology, component and machinery availability, service and marketing concepts, and so on. Such learning is facilitated by the ease of making site visits and frequent face-to-face contact (Porter, 1998);
(4) Congregate the talents. The main entity of innovation is talented people. The cluster firm provides advantages for the mobility of talented people within the cluster. The transaction of talents mobility within the cluster is rather low, and the connections among the cluster firms offer the talents convenient conditions and paths. This optimizes the deployment of human resource, and speeds up the regional innovation process;
(5) Construct cluster culture. Cluster innovation is a collective behavior by the economic bodies sharing similar behavior characteristics, which derives from the similar enterprise cultural background. Cluster innovation, based on the input-output chain, constructs the new regional innovation network with shared enterprise culture, thus optimizing the innovation milieu inside the cluster.

The cluster is a virtual form of firms' technological innovation, which obtains innovation advantage through the specialized division of labor and synergic competitive cooperation within the cluster. In the meanwhile, some external non-economic effect occurs due to the different operation goals, sense of cooperation and means of competition.

Co-existence of innovation laziness and innovation activeness

The synergism and spillover effects of cluster innovation bring about the external economic effect, as well as the innovation laziness. Unlike large enterprises, technological innovation in the SMEs is usually incremental. Such type of innovation makes it easy that the innovative firm's know-how, technology and operation conception be regarded as public products. It is difficult to restrain the use by other firms in the cluster at the same time. Under such a circumstance, the innovation property of a certain firm cannot be protected effectively, and the external economy from the innovation cannot be fully internalized. In addition to the high cost and risk of innovation, the low imitation cost and risk gives a big strike on the activeness of innovative firms, and consequently weakens the total innovation advantage of the cluster firm.

Over competition leading to the emergence of market for lemons

The market for lemons (Akerlof, 1970) is often used in information economics, to describe the phenomenon that sellers, when they acquire more information than buyers, sell products with lower quality to buyers so that the products with higher quality are driven out of the marketplace, and the product quality in the market keeps going down.
Within the industrial cluster, especially in the SME cluster, firms often choose "imitation" development mode. As a result of this structural similarity, it is easy to cause the risk of so-called "lemon market".

Each SME is only on very few taches in the highly specialized product chain of the cluster, with its fixed capital highly focused on certain production. Once there is industrial decline, it is difficult for the managers to handle the equipment with special use. They have to concede to operate or jerry-build in order to lower the cost, which results in the degradation of product quality, and unavoidably the appearance of “lemon market”. In the lemon market, firms find it hard to trust each other, which may damage the original cluster culture and finally destroy the cluster.

Path dependence leading to technology lockage

One of the competitive advantages of clusters is that it calls on the assembly of large amount of fore- and after firms. Such an assembly largely lowers the transaction costs, but it gradually makes the cluster a relatively closed system. Firms in the cluster become weaker in adapting to the external environment, forming path dependence in the end.

SMEs used to be weak in resisting risks. Once they are on a certain path, the SMEs may become more and more path dependent if the expected direction becomes clearer and stronger (Jiang, 2005). Such path dependence, on the one hand, positively adds to the cluster innovation trajectory, but it may have negative influence on the other hand. Technologies may enter the lockage state, which may be especially true for the traditional industrial cluster. Lockage of technology may lead to the internal cluster rigid and isolated, knowledge and technology toward similar. At last, the whole cluster may thus miss the original supplementary effect and lose innovation vitality and competitiveness.
In addition, the loose relationship between the cluster firms and the firms outside the cluster lowers to a certain extent the activeness of cluster firms in technological innovation. Therefore, clusters may cause SMEs to become path dependent, and get technology lockage so that they reject innovation.

Conclusion

In this paper, we analyzed the cluster innovation mechanism for the Chinese SMEs by using the firm behavior of horizontal and vertical cooperation and competition. Taking this as the basis, we explored the possible external effects by cluster innovation. On the one hand, cluster innovation can lower innovation cost and risk by promoting information spread, synergic competitive cooperation, sharing resources and facilities, congregate the talents and constructing cluster culture. On the other hand, cluster innovation may bring about external non-economical effects, like innovation laziness, “lemon market” and technology lockage, etc.. Different technological innovation characteristics bring about different non-economic external effect from various types of industrial cluster. Even if within the same industrial cluster, external effect may vary because of the characteristics of individual firms.

It is worth emphasizing that the innovation disadvantage of SMEs in China is not fully made because they are “small”, but because, to a large extent, they are isolated and they set up the separatist regime of their own. If the Chinese SMEs would carry out cooperative innovation and take benign competition, the innovation vitality and the innovation scale of SMEs could be combined effectively, thus exerting maximum effect. Because of this, we suggest that the Chinese SMS actively implement cluster innovation. In doing so, the SMEs can keep their flexible structure and quick reaction features. Meanwhile, the Chinese SMEs

still own the cluster advantages, and they can lower transaction costs, promote knowledge spillover, technology diffusion and share information.

Therefore, in regard to the Chinese SMEs, cluster innovation can still be an ideal industrial innovation model. To realize cluster innovation, the Chinese SME cluster firms need to share knowledge in a compatibility learning process; and to foster a benign competitive atmosphere for innovation in the cluster. However, this paper has mainly focused on the innovation generality of SME cluster. As for how innovation can be achieved by a specific Chinese industrial cluster, it will be our further empirical research.

References

Akerlof, G.A. (1970) The Market for "Lemons": Quality Uncertainty and the Market Mechanism**,** The Quarterly Journal of Economics, Vol. 84, No. 3, pp. 488-500.

Alfred, M. (1920), Industry and trade: A study of industrial technique and business organization, and of their influences on the conditions of various classes and nations, Macmillan and Co., Ltd., London.

Aydalot, P. (1986) Milieux innovateurs en Europe (Milieux innovators in Europe), Gremi, Paris.

Bathelt, H. (2002) The re-emergence of a media industry cluster in Leipzig, European Planning Studies, Vol. 10, No. 5, pp. 504-607.

DeBresson, C. (1999) An entrepreneur cannot innovate alone: Networks of enterprises are required, Paper presented at the DRUID Conference on Systems of Innovation, Aalborg, Denmark.

Feser, E.J. and Bergman, E.M. (2000) National industry cluster templates: A framework for applied regional cluster analysis, Regional Studies, Vol. 34, Iss. 1, pp. 1-19.

Gersbach, H. and Schmutzler, A. (2003) An Endogenous spillovers and incentives to innovate, Economic Theory, Vol. 21, pp. 59–79.

Gertler, M.S. (1993) Implementing advanced manufacturing technologies in mature industrial regions: Towards a social model of technology production, Regional Studies, Vol. 27, pp. 665–680.

Gordon, I.R. and McCann, P. (2000) Industrial clusters: complexes, agglomeration and/or social networks, Urban Studies, Vol. 37, pp. 5130-5132.

Jiang, D. (2005) SME industrial cluster: Risks and resolutions, Statistics and Decision Vol. 6, pp. 136-147.

Khan, J.H. and Ghani, J.A. (2004) Clusters and entrepreneurship: Implications for innovation in a developing economy, Journal of Developmental Entrepreneurship, Vol. 9, No. 3, pp. 221-238.

Krugman, P. (2000) Where in the world is the 'new economic geography'?, in Clark, G.L., Feldman, M.P. and Gertler, M.S. (eds): The Oxford handbook of economic geography, Oxford University Press, Oxford, pp. 49-60.

Malmberg, A. and Maskell, P. (1997) Towards an explanation of regional specialisation and industry agglomeration, European Planning Studies, Vol. 5, pp. 25-41.

Porter, M.E. (1976) The competitive advantage of nations, MacMillan Press.

Porter, M.E. (1998) Clusters and the new economics of competition, Harvard Business Review, Vol. 76, No. 6, pp. 77-90.

Qiu, B. (1999) Research on small firm cluster, Fudan University Press, Shanghai.

Schmitz, H. (1995) Collective efficiency: Growth path for small-scale industry, Journal of Development Studies, Vol. 31, No. 4, pp. 529-566.

Shang, Y. and Zhu, C. (1999) The power and practice of regional innovation system, China Economy Press, Beijing.

Wang, J. (2001) Innovation space: Cluster firm and regional development, Beijing University Press, Beijing.

Wei, J. and Ye, B. (2002) Cluster firm innovation: Cluster learning and squeeze effect, China Soft Science*,* Vol. 12, pp. 38-42.